The Relationship Between The Intraocular Pressures Of Both The Eyes Before And After Water Ingestion

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ABSTRACT

Background: Oral water ingestion increases the blood volume, and hence the blood pressure, which in turn increases the intraocular pressure (IOP).

Aim: To know the effect of water ingestion on the IOP and the relationship between the IOPs of both the eyes, before and after water ingestion.

Settings and design: This comparative study was conducted on 36 male medical students in the department of Physiology.

Material and Methods: This study was conducted on 36 male medical students. The IOP was recorded every 30 minutes for 2 hours before and after water ingestion, with the subjects in the supine position, by using a Schiotz tonometer.

Statistical analysis: It was done by paired t test using SPSS 15.0 version.

Results: It was found that water ingestion increases the IOPs of both the eyes. The IOP of the left eye was insigficantly more by 0.2mmHg than that of the right eye in the control trial, but this was not so in the study trial. The transient increase in IOP was quick in the left eye than in the right eye after water ingestion.

Conclusion: It can be concluded that there is a difference between the IOPs of both the eyes, before and after water ingestion, whose cause cannot be clearly explained and therefore, this needs a further in depth study of the anatomical and physiological processes that govern the maintenance of the IOPs in both the eyes individually. This would also explain to a variable extent, the aetiology of some cases of unilateral glaucoma.

Key Words : Intraocular pressure, water ingestion, normal eyes, glaucoma.

KEY MESSAGES:

- There is a difference between the IOPs of both eyes, before and after water ingestion.
- This would explain to a variable extent, the aetiology of some cases of unilateral glaucoma.

INTRODUCTION

Intraocular pressure is the pressure exerted by the aqueous humour, which is a clear optically transparent fluid filling the anterior and posterior chambers of the eye, on the coats of the anterior segment of the eyeball[1]. The normal intraocular pressure (IOP) is 10-21 mmHg (mean, 16 ± 2.5 mmHg)[2]. The precise mechanism of aqueous formation is yet to be elucidated. Despite vast scientific research and improvement in the analytical techniques, Leber's theory of simple filtration was originally accepted for a long time. This simple theory could not account for the presence of certain substances in higher concentrations and the absence of a few others and this led to the elucidation of various other mechanisms[3] such as -

- Ultrafiltration
- The Secretion-Diffusion theory
- Pinocytosis

Some of the factors affecting the aqueous humour formation[3] are-

- Lumen changes in the blood vessels of the eye
- Changes in the blood-aqueous barrier
- Changes in the intraocular pressure due to changes in the blood composition

The maintenance of the IOP is determined by the equilibrium between those forces which drive the fluid into the eye and those forces which oppose its escape[3].

Various studies have been done to know the differences between the IOPs of the right and left eyes. But, the results are different. In the literature, the assessment of the differences between the IOPs of the right and left eyes before and after water ingestion, which is most commonly used as a provocative test in the diagnosis of glaucoma, is also not available. Therefore, the present study was undertaken to know the effect of water ingestion on the IOPs of both the eyes.

MATERIAL AND METHODS

This was a comparative study showing the effect of water ingestion on the intraocular pressure (IOP) and the relationship between the IOPs of the right and left eyes in young, healthy, male adults in the age group of 17 to 20 years.

The study was conducted on 36 first year MBBS students. Informed consent was obtained from each student. Ethical clearance was obtained from the institution. The same set of students were chosen for a control trial (before water ingestion) as well as for a study trial (after water ingestion), in order to avoid the confounding factors. Only apparently healthy male students with emmetropia were included in the study. Subjects with refractive errors and a history of ocular trauma or ocular surgery were excluded.

Anthropometric parameters like height in centimeters and weight in kilograms were also recorded.

During the control trial, the IOPs of both the eyes were recorded in the lying down position by the indentation method at every 0, 30, 60, 90, and 120 mintues under aseptic precautions after the instillation of xylocaine eye drops, by using a Schiotz tonometer. Later on, during the study trial, the students were asked to consume water (2% of their body weights) over a period of 5 min. Again, the IOPs of both the eyes were recorded in the lying down position by the indentation method at every 0, 30, 60, 90, and 120 mintues under aseptic precautions after the instillation of xylocaine eye drops, by using a Schiotz tonometer.

The statistical analysis was done by using the SPSS software, version 15.0 under the guidance of a biostatistician. All the values were presented as mean ± standard deviation. The comparison of the mean values of the parameters between the two trials was done by using the paired t test. A p value less than 0.05 was considered to be significant.

RESULTS

This was a comparative study showing the effect of water ingestion on the intraocular pressure (IOP) and the relationship between the IOPs of the right and left eyes in young, healthy, male adults in the age group of 17 to 20 years.

All the values were presented as mean ± standard deviation. The mean age of the subjects was 18.36 + 0.833 (range 17 to 20 years), the mean height (cm) was 170.94 + 4.99 and the mean weight (kg) was 59.88 + 10.19.

Time	RIOP control (in mmHg)	LIOP control (in mmHg)	RIOP study (in mmHg)	LIOP study (in mmHg)
0 min	16.76±3.15	16.96±2.44	17.03±2.11	16.96±2.69
30 min	16.19±3.18	16.41±2.68	17.04±2.75	17.76*±2.88
60 min	15.69±2.79	16.3±2.57	16.3*±2.49	16.08±2.61
90 min	15.43±2.90	15.61±2.70	15.88±2.2	15.85±2.18
120 min	15.43±2.90	15.61±2.7	15.89±1.98	15.75*±2.07

[Table/Fig-1] : . IOP of right and left eye in control and study trials
* p Value < 0.05, statistically significant
RIOP: Right eye intraocular pressure
LIOP: Left eye intraocular pressure

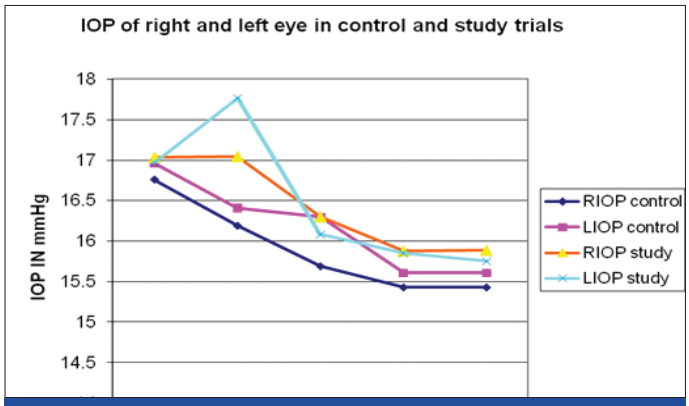
INTRAOCULAR PRESSURE

A) Control trial [Table /Fig-1&2]

1. The IOP of the right eye (in mmHg) decreased from the basal value (16.76 ± 3.15) at all the intervals. The decrease of 1 mm Hg between the 60 to 120 min intervals was statistically significant (P<0.05).
2. The IOP of the left eye insignificantly decreased by about 1 mmHg from the basal value (16.96 ± 2.44) at all the intervals.
3. When the IOPs of both the eyes were compared, the IOP of left eye as compared to the right eye, showed a significant increase of about 1 mmHg at the 60 minute interval (P<0.05).

B) Study trial [Table /Fig-1&2]

1. The IOP of the right eye showed an insignificant increase at the 30 min interval which then gradually showed a decline up to the 120 min interval. The decrease at the 90 and 120 min intervals was significant as compared to the basal value (17.03 ± 2.11).
2. The IOP of the left eye showed an insignificant increase at the 30 min interval, which later gradually decreased up to the 120 min interval below the basal value. The decrease at the 90 and 120 min intervals was significant as compared to the basal value (16.96 ± 2.69)



[Table/Fig-2]

3. When the IOP of both the eyes were compared, the IOP of the left eye showed a significant increase by 0.72 mmHg as compared to that of the right eye, at the 30 minute interval.

C) Comparison of the study trial with the control trial [Table /Fig-1&2]

1. Right eye IOP: There was a significant increase by about 1mmHg in the study trial as compared to the control trial, at the 60 minute interval.
2. Left eye IOP: There was a significant increase by about 1mmHg in the study trial as compared to the control trial, at the 30 minute interval.

DISCUSSION

In our study, there was a transient increase in the IOP in both the eyes in the study trial (after water ingestion) at the 30 minute interval. Similar findings, in the form of a transient increase in the IOP after water ingestion, were observed by Moura et al [4] in their study on 6 healthy male subjects.

A transient increase in aqueous production and slightly elevated IOP can be induced by the rapid ingestion of fluid (water-drinking test) in an eye with normal aqueous out flow[5]. This was found to be true from our study.

Comparison of the IOP between the Right and Left eyes:

When the IOP between the right and left eyes were compared, in both the control and the study trials at different time intervals for two hours, it was found that in the control trial, the IOP of the left eye was insignificantly more than the IOP of the right eye at all intervals by about 0.2mm Hg. But this was not so in the study trial. In the study trial, the IOP showed a transiently significant increase by 1mm Hg in both the eyes. In the left eye, the significant increase was at the 30 minute interval and in the right eye, it was at the 60 minute interval. This transient increase may be attributed to an increased filtration of aqueous fluid in the ciliary body, owing to the increased perfusion pressure in the ciliary arteries. The transient, sudden increase in the left eye as compared to the right eye may be due to the anatomical variation in the origin of the left common carotid artery, which is a direct branch of the aorta[6].

Booth F.M[7], in his study with non contact tonometers, found that the IOP of the left eye was more than the IOP of the right eye in subjects having higher IOP, but not in subjects having normal IOP. Kocak et al[8], in their study, found no variation between the IOPs of the right and left eyes.

Vernon et al [9], in their study, found that the IOP of the right eye was more than that of the left eye.

John et al [10], in their study in young (18-25 years) and older (40-74) subjects who were housed for 24 hours in a sleep laboratory, found that the IOP of the right eye was more by about 0.3 to 0.9 mm Hg throughout the 24 hours and that this increase in the right eye was attributed to the recording of the IOP on the right side first and to a larger proportion of the experimental subjects with right hand and eye dominance. This was in contrast to our findings, where the IOP was more by about 0.2mm Hg in the left eye in the control trial, in spite of our recording on the right side first and in all the experimental subjects with right hand dominance. This may be due to the origin of the left common carotid artery which is a direct branch of the aorta 6.

Thus, it can be concluded that there is a difference between the IOP of both the eyes, before and after water ingestion, whose cause cannot be clearly explained and therefore, this needs a further in depth study of the anatomical and physiological processes that govern the maintenance of the IOP in both the eyes individually. This would also explain to a variable extent, the aetiology of some cases of unilateral glaucoma.

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